United Nations

INTERNATIONAL CONFERENCE ON WATER AND THE ENVIRONMENT:
Development issues for the 21st century
26 - 31 January 1992, Dublin, Ireland

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MESSAGE BY

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to the

The International Conference on Water and the Environment: Development Issues for the 21st Century (ICWE)

There can be no issue that more conclusively demonstrates the integrated nature of environment and development than that of freshwater. The challenge of securing for all the basic human need of a reliable supply of freshwater, adequate in quality and quantity, is perhaps the most fundamental development issue. At the same time, the question of freshwater is connected to most major environmental issues.

A casual examination of the main linkages between freshwater and other issues in environment and development reveals just how pervasive an issue it is. Agriculture, for example, is almost totally dependent on the regular supply of freshwater, accounting for roughly two-thirds of its use. Recent investigations have shown that a major source of contamination of freshwater can be traced to air-borne pollutants. Both surface and ground water are increasingly contaminated by toxic chemicals and hazardous wastes, and some of these substances can pose a serious threat to health on the timescale of hundreds of years. Health, of course, is most directly associated with problems in the supply of freshwater: data suggest that some 5 million children under five years of age die each year from lack of potable water and sanitary facilities. In general, 80% of all diseases and more than 33% of deaths in developing countries have been linked to consumption of contaminated water, and on the average as much as 10% of each person's productive time is sacrificed to water-related diseases.

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The International Conference on Water and the Environment to be held in Dublin will address these concerns in an integrated manner that takes into consideration their linkages to other issues. The Dublin meeting is an extremely important part of the UNCED process. The discussions at Dublin by government-designated experts and professionals from intergovernmental and non-governmental organizations will offer valuable substantive submissions that will assist in shaping up and finalising the freshwater component of the UNCED Action Programme, otherwise called "Agenda 21."

Complex and demanding though the task in Dublin may be, I am convinced the outcome of these important deliberations will help, through Agenda 21, to chart the future course for effective and integrated management of our vital and fragile freshwater resources, and I look forward to receiving the results of this Conference, which will be extremely valuable.

International Conference on Water and the Environment:

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THE DUBLIN STATEMENT

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THE DUBLIN STATEMENT
ON WATER AND SUSTAINABLE DEVELOPMENT

Scarcity and misuse of freshwater pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development and the ecosystems on which they depend, are all at risk, unless water and land resources are managed more effectively in the present decade and beyond than they have been in the past.

Five hundred participants, including government-designated experts from a hundred countries and representatives of eighty international, intergovernmental and non-governmental organizations attended the International Conference on Water and the Environment (ICWE) in Dublin, Ireland, on 26-31 January 1992. The experts saw the emerging global water resources picture as critical. At its closing session, the Conference adopted this Dublin Statement and the Conference Report. The problems highlighted are not speculative in nature; nor are they likely to affect our planet only in the distant future. They are here and they affect humanity now. The future survival of many millions of people demands immediate and effective action.

The Conference participants call for fundamental new approaches to the assessment, development and management of freshwater resources, which can only be brought about through political commitment and involvement from the highest levels of government to the smallest communities. Commitment will need to be backed by substantial and immediate investments, public awareness campaigns, legislative and institutional changes, technology development, and capacity building programmes. Underlying all these must be a greater recognition of the interdependence of all peoples, and of their place in the natural world.

In commending this Dublin Statement to the world leaders assembled at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, the Conference participants urge all governments to study carefully the specific activities and means of implementation recommended in the Conference Report, and to translate those recommendations into urgent action programmes for WATER AND SUSTAINABLE DEVELOPMENT.

GUIDING PRINCIPLES

Concerted action is needed to reverse the present trends of overconsumption, pollution, and rising threats from drought and floods. The Conference Report sets out recommendations for action at local, national and international levels, based on four guiding principles.

Principle No. 1 – Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

Principle No. 2 – Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

Principle No. 3 – Women play a central part in the provision, management and safeguarding of water

This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

Principle No. 4 – Water has an economic value in all its competing uses and should be recognized as an economic good.

Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

THE ACTION AGENDA

Based on these four guiding principles, the Conference participants developed recommendations which enable countries to tackle their water resources problems on a wide range of fronts. The major benefits to come from implementation of the Dublin recommendations will be:

Alleviation of Poverty and Disease

At the start of the 1990s, more than a quarter of the world's population still lack the basic human needs of enough food to eat, a clean water supply and hygienic means of sanitation. The Conference recommends that priority be given in water resources development and management to the accelerated provision of food, water and sanitation to these unserved millions.

Protection against natural disasters

Lack of preparedness, often aggravated by lack of data, means that droughts and floods take a huge toll in deaths, misery and economic loss. Economic losses from natural disasters, including floods and droughts, increased three-fold between the 1960s and the 1980s. Development is being set back for years in some developing countries, because investments have not been made in basic data collection and disaster preparedness. Projected climate change and rising sea levels will intensify the risk for some, while also threatening the apparent security of existing water resources.

Damages and loss of life from floods and droughts can be drastically reduced by the disaster preparedness actions recommended in the Dublin Conference Report.

Water Conservation and Reuse

Current patterns of water use involve excessive waste. There is great scope for water savings in agriculture, in industry and in domestic water supplies.

Irrigated agriculture accounts for about 80% of water withdrawals in the world. In many irrigation schemes, up to 60% of this water is lost on its way from the source to the plant. More efficient irrigation practices will lead to substantial freshwater savings.

Recycling could reduce the consumption of many industrial consumers by 50% or more, with the additional benefit of reduced pollution. Application of the "polluter pays" principle and realistic water pricing will encourage conservation and reuse. On average, 36% of the water produced by urban water utilities in developing countries is "unaccounted for". Better management could reduce these costly losses.

Combined savings in agriculture, industry and domestic water supplies could significantly defer investment in costly new water resource development and have enormous impact on the sustainability of future supplies. More savings will come from multiple use of water. Compliance with effective discharge standards, based on new water protection objectives, will enable successive downstream consumers to reuse water which presently is too contaminated after the first use.

Sustainable Urban Development

The sustainability of urban growth is threatened by curtailment of the copious supplies of cheap water, as a result of the depletion and degradation caused by past profligacy. After a generation or more of excessive water use and reckless discharge of municipal and industrial wastes, the situation in the majority of the world's major cities is appalling and getting worse. As water scarcity and pollution force development of ever more distant sources, marginal costs of meeting fresh demands are growing rapidly. Future guaranteed supplies must be based on appropriate water charges and discharge controls. Residual contamination of land and water can no longer be seen as a reasonable trade-off for the jobs and prosperity brought by industrial growth.

Agricultural Production and Rural Water Supply

Achieving food security is a high priority in many countries, and agriculture must not only provide food for rising populations, but also save water for other uses. The challenge is to develop and apply water-saving technology and management methods, and, through capacity building, enable communities to introduce institutions and incentives for the rural population to adopt new approaches, for both rainfed and irrigated agriculture. The rural population must also have better access to a potable water supply and to sanitation services. It is an immense task, but not an impossible one, provided appropriate policies and programmes are adopted at all levels - local, national and international.

Protecting Aquatic Ecosystems

Water is a vital part of the environment and a home for many forms of life on which the well-being of humans ultimately depends. Disruption of flows has reduced the productivity of many such ecosystems, devastated fisheries, agriculture and grazing, and marginalized the rural communities which rely on these. Various kinds of pollution, including transboundary pollution, exacerbate these problems, degrade water supplies, require more expensive water treatment, destroy aquatic fauna, and deny recreation opportunities.

Integrated management of river basins provides the opportunity to safeguard aquatic ecosystems, and make their benefits available to society on a sustainable basis.

Resolving Water Conflicts

The most appropriate geographical entity for the planning and management of water resources is the river basin, including surface and groundwater. Ideally, the effective integrated planning and development of transboundary river or lake basins has similar institutional requirements to a basin entirely within one country. The essential function of existing international basin organizations is one of reconciling and harmonizing the interests of riparian countries, monitoring water quantity and quality, development of concerted action programmes, exchange of information, and enforcing agreements.

In the coming decades, management of international watersheds will greatly increase in importance. A high priority should therefore be given to the preparation and implementation of integrated management plans, endorsed by all affected governments and backed by international agreements.

THE ENABLING ENVIRONMENT

Implementation of action programmes for Water and Sustainable Development will require a substantial investment, not only in the capital projects concerned, but, crucially, in building the capacity of people and institutions to plan and implement those projects.

The Knowledge Base

Measurement of components of the water cycle, in quantity and quality, and of other characterisitics of the environment affecting water are an essential basis for undertaking effective water management. Research and analysis techniques, applied on an interdisciplinary basis, permit the understanding of these data and their application to many uses.

With the threat of global warming due to increasing greenhouse gas concentrations in the atmosphere, the need for measurements and data exchange on the hydrological cycle on a global scale is evident. The data are required to understand both the world's climate system and the potential impacts on water resources of climate change and sea level rise. All countries must participate and, where necessary, be assisted to take part in the global monitoring, the study of the effects and the development of appropriate response strategies.

Capacity Building

All actions identified in the Dublin Conference Report require well-trained and qualified personnel. Countries should identify, as part of national development plans, training needs for water resources assessment and management, and take steps internally and, if necessary with technical co-operation agencies, to provide the required training, and working conditions which help to retain the trained personnel.

Governments must also assess their capacity to equip their water and other specialists to implement the full range of activities for integrated water resources management. This requires provision of an enabling environment in terms of institutional and legal arrangements, including those for effective water demand management.

Awareness raising is a vital part of a participatory approach to water resources management. Information, education and communication support programmes must be an integral part of the development process.

FOLLOW-UP

Experience has shown that progress towards implementing the actions and achieving the goals of water programmes requires follow-up mechanisms for periodic assessments at national and international levels.

In the framework of the follow-up procedures developed by UNCED for Agenda 21, all Governments should initiate periodic assessments of progress. At the international level, United Nations institutions concerned with water should be strengthened to undertake the assessment and follow-up process. In addition, to involve private institutions, regional and non-governmental organisations along with all interested governments in the assessment and follow-up, the Conference proposes, for consideration by UNCED, a world water forum or council to which all such groups could adhere.

It is proposed that the first full assessment on implementation of the recommended programme should be undertaken by the year 2000.

UNCED is urged to consider the financial requirements for water-related programmes, in accordance with the above principles, in the funding for implementation of Agenda 21. Such considerations must include realistic targets for the timeframe for implementation of the programmes, the internal and external resources needed, and the means of mobilizing these.

The International Conference on Water and the Environment began with a Water Ceremony in which children from all parts of the world made a moving plea to the assembled experts to play their part in preserving precious water resources for future generations.

In transmitting this Dublin Statement to a world audience, the Conference participants urge all those involved in the development and management of our water resources to allow the message of those children to direct their future actions.

International Conference on Water and the Environment:

Development issues for the 21st century

26-31 January 1992, Dublin, Ireland

REPORT OF THE CONFERENCE

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1. INTRODUCTION

1.1 The International Conference on Water and the Environment was convened in Dublin, Ireland, from 26 to 31 January 1992. The Conference was attended by five hundred participants, including government-designated experts from a hundred countries and representatives of eighty international, intergovernmental and non-governmental organizations. The list of participants is contained in Annex I of the report.

1.2 The Conference was opened by His Excellency Mr. Charles Haughey, Prime Minister of Ireland, who welcomed the participants on behalf of his Government, and highlighted the seriousness of the problem of water availability to sustain human life, support economic development and maintain ecosystems. Professor Godwin Obasi, Secretary-General of the World Meteorological Organization, Dr. Mustafa Tolba, Executive Director of the United Nations Environment Programme, and Dr. Arcot Ramachandran, Executive Director of the United Nations Centre for Human Settlements welcomed the participants on behalf of the Organizations of the United Nations system. The opening session was addressed by His Excellency Dr. Rory O'Hanlon, Minister for Environment and by His Excellency Mr. Carlos Borrego, Minister for the Environment and Natural Resources of Portugal on behalf of the European Community.

1.3 Mr. James Dooge (Ireland) was elected Chairman of the Conference and Ms. Claudia Candanedo (Panama) was elected Rapporteur. Messrs Abbas Hidaytalla Abdullah (Sudan), James Bruce (Canada), Odon Starosolszky (Hungary), Jose Luis Calderón (Mexico), Chandra Sharma (Nepal), and Mahmoud Abou-Zeid (Egypt) were elected vice chairmen of the Conference. The programme of work for the Conference is contained in Annex II of the report.

1.4 The Vice-chairmen of the Conference acted respectively as chairmen of the working groups on: Integrated Water Resources Development and Management (working group A), Mechanisms for Implementation and Co-ordination at the International, National and Local Levels (working group B), Water Resources Assessment and Impacts of Climate Change on Water Resources (working group C), Protection of Water Resources, Water Quality and Aquatic Ecosystems (working group D), Water and Sustainable Urban Development and Drinking Water Supply and Sanitation in the Urban Context (working group E), and Water for Sustainable Food Production and Rural Development and for Drinking Water Supply and Sanitation in the Rural Context (working group F). Mr. Mohamed Abdulrazzak (Saudi Arabia) was elected as Vice-Chairman for working group A, and Mr. Ainun Nishat (Bangladesh) as Rappporteur. Mr. Mohammed Jellali (Morocco) was elected as Vice-Chairman of working group B, and Mr. Abdul Karim Al-Fusail (Yemen) as Rapporteur. Mr. Karl Hofius (Germany) was elected as Vice-Chairman of working group C, and Mr. Moremi Sekwale (Botswana) as Rapporteur. Mr. Ivan Zavadsky (Czechoslovakia) was elected as Vice-Chairman of working group D, and Ms. LaJuana Wilcher (United States of America) as Rapporteur. Mr. Gabriel Arduino (Uruguay) was elected Vice-Chairman of working group E, and Ms. Ebele Okeke (Nigeria) as Rapporteur. Mr. David Constable (Australia) was elected Vice-Chairman of working group F, and Mr. Mario Fuschini-Mejía (Argentina) as Rappporteur.

1.5 The main focus of the Conference was on the development, management and utilization of water resources in harmony with environmental conservation and the concept of sustainability. The latter concept indicates the need to promote:

(a) The synthesis of economic, social and environmental considerations.

(b) Processes which compare and evaluate alternatives which do not deplete the resource base and thus not affect present and future generations.

(c) The greatest possible efficiency in the use of water and energy, including appropriate and safe reuse, recycling, and conservation of all water resources.

(d) Reduction of pollutants and pathogens in water and aquatic ecosystems.

(e) The quality of human life and the protection of the biosphere.

(f) Flood and drought preparedness systems as an integral part of the concept of sustainability and economic development.

1.6 The concept of sustainability also recognizes the interrelation with other natural resources. This requires an explicit understanding of the role played by ecosystems in maintaining the quality and quantity of freshwater resources, and the reciprocal dependence of natural aquatic ecosystems on the maintenance of adequate freshwater flows.

1.7 The Conference further recognizes the central role of women in the provision, management and safeguarding of water, and that every human being has the right of reasonable access to clean water and sanitation.

1.8 As we rapidly approach the twenty-first century, it is apparent that throughout the world, management of our freshwater resources must change to meet the goal of sustainable development. The Conference was the first major meeting of world experts to focus on the holistic management of water in its proper context, that is, in the integrated spectrum of human and environmental uses and needs, as opposed to particular sectoral needs.

1.9 Development has stressed freshwater ecosystems. Human consumption, industrial and agricultural production, and the modification of freshwater systems to support this development have resulted in the diminution or loss of many aquatic species, and habitat degradation. These losses, in turn, have adversely affected human health and development as fisheries, wildlife, flood protection and overall water quality have declined. To achieve long term, sustainable development, such adverse environmental effects must be avoided. Sustainable water resource development is development that promotes the quality of human existence and the natural functions of the biosphere.

1.10 The Report of the Conference and the Dublin Statement were adopted by consensus. In the case of a few paragraphs, the extent of the consensus was determined by a show of hands.

1.11 The participants at the Conference recognized the need for fundamental new approaches to development and management which can only be brought about through political commitment and involvement from the highest levels of government to the smallest communities. The participants, through the world leaders assembled at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992, urge all governments to study and undertake the specific activities and means of implementation recommended in the body of this report, and to translate its recommendations into urgent programmes for WATER AND SUSTAINABLE DEVELOPMENT.

2. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

Principles

2.1 These findings are drawn from the large and diversified experience gained among all countries since the United Nations Water Conference, Mar del Plata 1977. They identify some serious errors and unwise biases, and at the same time point to numerous fruitful advances in understanding and action. We look to the future with humility and greater confidence. There emerged four main principles that need to be applied in taking action to achieve integrated water resources development and management.

2.2 The first principle is that since water sustains all life forms, a holistic approach is needed for the development of human societies and economies, and the protection of natural ecosystems on which the survival of humanity ultimately depends. This includes not only the need to look at the whole water cycle (including the distribution of rainfall, the conservation of sources, the systems of supply and waste-water treatment, and the interaction with the natural environment and land use), but also the inter-sectoral needs. It must also include an ecological approach, respect existing ecosystems and consider issues across the whole of a river basin or a groundwater aquifer and also consider the interrelation with other natural resources. Where catchments cross national boundaries, international cooperation is essential.

2.3 The second principle is the need for a participatory approach in institutions and arrangements for water development and management. This also has implications for training and education. A participatory approach requires:

- the participation of beneficiaries (water users) and the public, with particular emphasis on the involvement of women in planning, implementing and evaluating water projects;
- raising awareness of the importance of water among policy-makers and the general public;
- public consultation;
- decisions at the lowest appropriate level, in order to bring decision-making as close as possible to those affected.

2.4 The third principle is the need to recognize the central role of women in the provision, management and safeguarding of water, which has seldom been given sufficient prominence.

2.5 The fourth principle is the recognition that water has an economic value and, therefore, should be considered as an economic good. In evaluating such a good, it is essential to ensure that proper regard is paid to:

- the importance of water to society, which requires that everyone, particularly women and the underprivileged, should have a right of reasonable access at an affordable price;
- sustainable development;
- demand management for efficient and equitable resource use;
- environmental factors, to ensure that external costs and benefits are properly included;
- financial viability and accountability.

Actions

2.6 To give effect to these principles, a number of actions were identified which will involve multilateral and bilateral co-operation.

Capacity building

Information base and know-how

2.7 Adequate and comparable information is essential for sound decisions. The Conference identified the need for every institution taking decisions in this field and for the public to have the best feasible access to:

- information on water resources, both surface water and ground water, quantity and quality;
- water use data and information for those concerned in, or affected by, that water and their likely development and demands;
- social and economic data;
- information on the natural environment.

This may involve co-ordination of existing data bases. Continued scientific and technological research and the sharing and dissemination of know-how is also essential.

2.8 These data need to be validated, kept up-to-date and to be accompanied with evaluations and assessments, in order to analyse the effects of decisions based upon them. Only in this way can the development and management of the water resources be made responsive to demands and be enabled to influence the way in which those demands develop.

Human resources development

2.9 To implement these principles, communities need to have adequate capacities. Those who establish the framework for water development and management at any level, whether international, national or local need to ensure that the means exist to build those capacities.

2.10 These means will vary from case to case. They usually include:

- awareness-creation programmes including mobilizing commitment and support at all levels and initiating global and local action to promote such programmes;
- the training of water managers at all levels so that they have an appropriate understanding of all the elements necessary for their decisions;
- the strengthening of training capacities in developing countries;
- appropriate training of the necessary professionals including extension workers;
- improvement of career structures;
- sharing of appropriate knowledge and technology, both for the collection of data and for the implementation of planned development; this should include non-polluting technologies and the knowledge needed to extract the best performance from existing investment and systems;

Public awareness

2.11 To promote the general education of the public about the proper use of water and its economic value, the factors which need to be taken into account and the methods by which decisions are taken with full public participation.

Institutional and legal arrangements

2.12 *Management at the lowest appropriate level:* Recognizing the need for a central mechanism capable of ensuring co-ordination of national social and economic interests, the role of governments needs to be reviewed to ensure that users, local institutions and the formal and informal private sector can play a more direct part. A key aim must be to improve accountability to the public. The levels at which management decisions can be taken and problems solved will vary widely from country to country and case to case. In any given situation, however, water resources should be managed at the lowest appropriate levels. Integrated water resources development and management therefore should be delegated to those lowest appropriate levels which would ensure the representation of those concerned or affected and integration of sectoral demands. These may be existing bodies, institutions and mechanisms or special river basin authorities. Consistent with such institutional structures is a greater reliance on incentives, prices and markets and less reliance on traditional command and control approaches.

2.13 *National level*: Higher management levels and the national level will play a very important role in ensuring the availability of the information, co-ordination, policy development, planning, the legal framework, and the development of human resources, which are all needed for integrated water resources development and management , including sector integration. In many cases there will be a need to identify a national administrative unit for effective co-ordination, which should preferably not be a water user.

2.14 *International level*: In many cases, the integrated water resources development and management of transboundary water resources will raise the need for international co-operation and mechanisms at international or regional levels to facilitate inter-country agreement on the co-ordination of the management of such resources in an economically and environmentally sound manner. A coherent approach by all international organizations is also needed.

2.15 *Law*: The national legal framework for integrated water resources development and management decisions need to be clear and be consistent with the above principles. International law is needed to facilitate bilateral or regional agreements on transboundary integrated water resources development and management. In this context, an international seminar should be organized as soon as possible, to examine the legal aspects of integrated water resources development and management at international, national and local levels.

Implementation Considerations:

2.16 *Planning*: Water resources development and management should be planned in an integrated manner, taking into account long-term planning needs as well as shorter horizons, i.e. it should incorporate environmental, economic and social considerations based on the principle of sustainability; it should include the requirements of all users as well as those relating to the prevention and mitigation of water-related hazards; and it should be an integral part of the socio-economic development planning process. A prerequisite for sustainable management of water as a scarce and vulnerable resource is that its full costs should be acknowledged in all planning and development. Planning considerations should reflect benefits investment, environmental protection and operation costs, as well as the opportunity costs reflecting the most valuable alternative use of water. Actual charging need not necessarily burden all beneficiaries with these. Charging mechanisms should, however, reflect as far as possible both the true cost of water when used as an economic good and the ability of the communities to pay.

2.17 *Demand-management*: The role of water as an economic and life-sustaining good should be reflected in demand management mechanisms, implemented through:

- water conservation and re-use;
- resource assessment;
- financial instruments;

- impact monitoring.

2.18 *Finance*: In all this, it will be necessary to consider the sources and methods of financing. Local, national and external sources of finance, public and private, will need to be mobilized.

2.19 *Investment*: The setting of priorities afresh for private and public investment strategies should take place taking into account:

- maximum utilization of existing projects, through maintenance, rehabilitation and optimal operation;

- new or alternative clean technologies;

- environmentally and socially benign hydro-power.

2.20 It is necessary to ensure consultation among all parties involved prior to approval for funding of any water-related United Nations project or programme.

2.21 Appropriate mechanisms must be found to correct the negative effects of structural adjustment in depriving the poor of their right of access to drinking water.

3. WATER RESOURCES ASSESSMENT AND IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

Introduction

3.1 Water resources assessment is the determination of the quantity, quality and availability of water resources, on which is based an evaluation of the possibilities for their sustainable development, management and control.

3.2 Water resources assessment is a prerequisite for sustainable development and management of the world's water resources. It provides the basis for the vast range of activities where water is involved. Without detailed water resources assessment it is impossible properly to plan, design, construct, operate and maintain projects for irrigation and drainage; mitigation of flood losses; industrial and domestic water supply; urban drainage; energy production (including hydropower); health; agriculture; fisheries; drought mitigation and the preservation of aquatic ecosystems and coastal waters.

3.3 The nature of the decisions based on water resources assessment information may involve major capital investments with potentially massive environmental impacts. This demonstrates the value of water resources assessment activities, and their tangible and intangible benefits. Appropriate government policies and programmes are necessary to ensure sustainable development for the future. Thus there is a need for greater knowledge about the quantity and quality of surface and groundwater resources and for comprehensive monitoring to guide the management of these resources.

Institutional and Financial Framework in Support of Water Resources Assessment

3.4 The assessment of the water resources of a country is a national responsibility and the activities concerned should be designed to meet the specific needs of the country. Many of its component activities may be undertaken at local and provincial level. This national responsibility should be shared among neighbouring countries in the case of transboundary water resources, and international programmes and projects can provide valuable assistance.

3.5 Given the importance of assessment information to support sustainable development and the maintenance of ecosystem integrity, all countries are urged to achieve a level of water resources assessment activity appropriate to their needs as soon as is practicable.

3.6 Policy should be that all national and international water resources assessment activities are fully co-ordinated and funded on a long-term basis. The approach taken to achieve this may differ from country to country, but it will usually involve the establishment of regulations and a series of administrative decisions, particularly on the allocation of funds.

3.7 Water resources assessment requires considerable financial resources if it is to provide the support to sustainable socio-economic development These resources, however, represent only a small fraction (say 0.2 to 1.0%) of the funds spent on investment and operations in the water sector as a whole. Governments are urged to put priority on water resources assessment activities when allocating national and international funds.

3.8 Recommended actions include:

(a) Defining the information needs of users and establishing a national policy, a legislative framework, efficient institutional structures and economic instruments appropriate for water resources assessment.

(b) Establishing and maintaining effective co-operation in water resources assessment and hydrological forecasting activities between national agencies within a country, and between countries with regard to transboundary water resources.

(c) Encouraging those responsible for collecting and storing data to apply the methodologies that have been developed and endorsed at the international level when evaluating their water resources assessment activities.

(d) Developing and disseminating information on means of estimating benefits and costs of water resources assessment activities and assisting national services to demonstrate the benefits of water resources assessment.

(e) Making practical and legislative provisions for the long-term sustainability of water resources assessment and forecasting activities, and allocating the necessary financial resources, especially in the case of developing countries.

Collection and storage of water-related information

3.9 Reliable information on the condition and trends of a country's water resources - surface water, water in the unsaturated zone and groundwater, quantity and quality - is required for a number of purposes, such as: assessing the resource and its potential for supplying the current and foreseeable demand; protecting people and property against water-related hazards; planning, designing and operating water projects; and monitoring the response of water bodies to anthropogenic influences, to climate variability and change, and to other environmental factors.

3.10 Integrated monitoring and information systems should be established and data collected and stored on all aspects of water resources which are required for a full comprehension of the nature of those resources and for their sustainable development. These include not only hydrological data, but also related geological, climatological, hydrobiological and topographic data and data on soil types, land use, desertification and deforestation, as well as information on such topics as water use and re-use, sewage discharges, point and non-point sources of pollution and runoff to seas and oceans. This involves the installation of observation networks and other data gathering mechanisms designed to monitor various climatic and topographic regimes, plus the development of data storage facilities. Where, at national, regional and international levels, water-related information is handled by a number of information systems, it is important that these systems be co-ordinated.

3.11 Recommended actions include:

(a) Installing monitoring systems designed to provide valid and comparable water-related information.

(b) Ensuring the continuous operation of such systems in support of studies requiring long-term data, such as those relating to climate change.

(c) Upgrading facilities and procedures for storing, validating and safeguarding such data.

(d) Implementing techniques for processing such data and assimilating related information.

(e) Comparing, selecting and applying hydrological technology appropriate to each country's needs and ensuring the transfer of appropriate technology, particularly between hydrological services.

Assessment of the resource and dissemination of water information

3.12 Those who plan, design and operate water projects, and those who are concerned with the protection of life, property and the environment from natural or man-made disasters, should have access to the water-related information necessary for their work. They should be informed of the availability of such information and be able to obtain it in forms that are convenient for their use, including the free and urgent exchange of data required for mitigating natural disasters. Commercialization of water-related information should not prevent its full use, and dissemination of water-related information should be on a non-profit basis.

3.13 The approach is to assess the data and information needs of potential users and to match these with the services provided by information centres and forecasting systems. This includes the strengthening of existing global data bases and the call for countries to supply data to such bases. In this, increasing use will be made of geographic information systems and similar computer-based technology. One particular application of hydrological data is in the installation and operation of hydrological forecasting systems and related activities which are vital to safeguard lives and property in the face of major natural disasters.

3.14 Recommended actions include:

(a) Identifying the need for water-related data and analyzing and presenting such data in forms appropriate for planning and management of water resource development; and for other purposes such as studies of the impact of water development projects on the environment.

(b) Assembling and disseminating basin-wide, regional and global sets of water-related data and information for use, *inter alia*, in the management of resources within international river basins and in climate change studies.

(c) Assessing surface water and groundwater resources and the interactions between surface water and groundwater.

(d) Assessing the risk of flooding from rainfall runoff, snowmelt, storm surges and land-slides and installing hydrological forecasting and warning systems for areas subject to such risk.

(e) Assessing the risk of drought and installing drought warning systems in support of schemes to mitigate the effects of drought.

(f) Dissemination of these assessments to all requiring the information, and assuring the incorporation of water resource information in decision making processes.

Research and development in the water sciences

3.15 Water resources assessment, including studies of flooding, drought and desertification, and hydrological forecasting should be based on a sound understanding of the scientific principals involved and are dependant on technology for their implementation. Research and development activities should therefore be based on a strategic analysis of the very varied needs of countries. They should take account of, and strengthen indigenous expertise.

3.16 Recommended actions include:

(a) Establishing and strengthening research and development programmes appropriate to the needs of countries so as to increase understanding of the fundamental processes involved in the water cycle, including the interactions between water, land and the atmosphere, and to support water resources assessment and hydrological forecasting activities.

(b) Promoting the development of new technology for water resources assessment and hydrological forecasting, making full use of local expertise in this regard.

(c) Transferring appropriate technology to users.

(d) Strengthening relevant international and regional programmes both at national and global levels.

Impact of climate change and variability on freshwater resources and the hydrological cycle

3.17 Among the most important impacts of climate change will be its effects on the hydrological cycle and water management systems, and through these on socio-economic systems. Therefore, there is a need to acquire an adequate understanding of the potential impact of the predicted climate change on the availability and reliability of freshwater resources, on water demand, on the incidence of floods and droughts and on the consequences for the efficient management and safety of existing and future water-related projects and structures. This will permit the planning and implementation of effective counter-measures in the case of deleterious consequences and revised policies in the event of beneficial consequences. Efforts should be directed through both national and international programmes involving comprehensive monitoring, research and policy-review. Water-related data are therefore essential for studies related to climate change and variability.

3.18 Recommended actions include:

(a) Increasing the co-operation between climatological and hydrological communities in developing predictions of climate change for individual seasons and for specific regions.

(b) Strengthening capabilities to collect, store and process water-related data, including data related to climate change.

(c) Developing research programmes at national level and contributing to regional and international research projects on the question of climate change, its early detection and its impact on the hydrological regime. These should address the situation in developing as well as developed countries and could involve case studies designed to develop and test specific methodologies for impact assessment.

(d) Assessing the likely socio-economic and environmental impacts of such changes, developing response strategies and funding and implementing these strategies.

Impact of a sea-level rise resulting from climate change

3.19 Assessments should be made in all coastal zones and in particular in low-lying islands of the potential impact of any rise in sea-level resulting from climate change. This impact may be on the quality and quantity of freshwater resources or on the risk of flooding.

3.20 Recommended actions include:

(a) Strengthening capabilities to monitor rises in sea-level and related hydrological parameters.

(b) Developing techniques for assessing the potential impact of a sea-level rise on freshwater resources and flood risk.

(c) Assessing the likely socio-economic and environmental impacts of a rise in sea-level, developing response strategies and funding and implementing such strategies.

Human resources development

3.21 Salaries and wages commonly account for half or more of the expenditure of an effective programme for water resources assessment and hydrological forecasting. Because people are the most important resource available to the manager of such a programme, personnel matters should receive great attention. The aim should be to attract and retain personnel to work on water resources assessment who are sufficient in number and adequate in their level of education to ensure the effective implementation of the activities that are planned. Education may be called for at both national and international level, while adequate terms of employment are a national responsibility.

3.22 Recommended actions include:

(a) Identifying education and training needs geared to the specific requirements of countries.

(b) Establishing and strengthening education and training programmes on water-related topics, within an environmental and developmental context, for all categories of staff involved in water resources assessment activities, using advanced educational technology where appropriate and involving both men and women.

(c) Developing sound recruitment, personnel and pay policies for staff of national and local water agencies.

4. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

Introduction

4.1 Fresh water is a unitary resource. Long-term sustainable development of global fresh water requires holistic management of the resource and recognition of the inter-connectedness of the elements that comprise fresh water and impact its quality. Groundwater and surface water quality are inextricably linked. There is a growing recognition that issues of water quality cannot be considered separate from water quantity. The traditional emphasis on chemical indicators of water quality must be supplemented by more comprehensive indicators based on the total properties of a waterbody, including chemical, physical, biological, and ecological parameters. It must also be recognized that fresh water quality is impacted directly by natural and human activities outside the water sphere, such as land-use practices, erosion, and deforestation. Certain water quality problems are tied to acid deposition or natural contamination. Such problems often require monitoring and protection at the local level, while some have significant transboundary components which can be addressed only at the national and international level. All in all, the complex inter-connected nature of the fresh water system demands that fresh water management be holistic rather than piece-meal, systematically based rather than micro-managed, and based on a balanced consideration of the total needs of people and the environment.

Water Resources Protection and Conservation

4.2 Growing demands for water have brought increased pressures on finite supplies. An ecosystem approach is necessary to provide adequate quantities and qualities of water to all users and to protect ecosystem integrity over the long term.

4.3 There is a widespread lack of perception of the linkages between the development, management, use and treatment of water resources and aquatic ecosystems. A preventive approach is crucial to avoid costly subsequent measures to rehabilitate, treat and develop new water supplies.

4.4 By the year 2000 all countries, appropriate to their capacities, available resources and needs, and with the help of external support agencies, as appropriate, should have identified those surface and groundwater resources which could be developed for use on a sustainable basis and other major water dependent resources which can be developed. Simultaneously they should have initiated programmes for the protection, conservation and rational use of these resources on a sustainable basis.

4.5 Recommended actions include:

(a) Preparation of basin action plans, especially for priority high risk basins, including their rivers, lakes, and aquifers, designated at the national level (and at international levels, for those basins that transcend international boundaries), to integrate land-use planning with water management and conservation, to coordinate the activities of provincial, national and international agencies, to address transboundary issues, and to initiate contingency plans to control accidental spills and to respond to natural disasters.

(b) Establishment of appropriate legislation, enforcement and economic mechanisms for water resources protection and conservation at the national level with international co-operation to promote water conservation and recycling, pollution prevention and control, and environmentally-sound agricultural and industrial practices.

(c) Establishment of permanent, multi-sectoral planning and environmental impact assessment processes for water resources development and management covering hydrological, ecological, social, health, economic and meteorological aspects. These planning and evaluation processes should be used at the national and international levels in government agencies and external support agencies. External support agencies should include these processes in their action programmes.

(d) Development and application of water quality and water supply criteria for ecosystems and health protection to be implemented at local, provincial, national and international levels.

Monitoring and Surveillance of Water Resources

4.6 Monitoring, assessment and prediction of the quality and quantity of rivers, lakes and groundwaters through water, biota and sediment is a goal, whenever possible, for sound water resources management and protection. In addition to providing wildlife habitat, protecting and improving water quality and providing flood protection, aquatic systems are also linked to all other environmental components, and are therefore a powerful indicator of the overall environmental quality. Exact, complete and precise water quality data are needed from the local level to the international level for transboundary water bodies, and to the global scale where rivers provide a major input of pollutants to seas and oceans.

4.7 By the year 2000 all countries should have established appropriate assessment programmes of their water resources, and should participate in regional (e.g. basin level) and international water quality and quantity assessments. These efforts should be matched to their capacities, available resources and needs, and assisted by external support agencies, as appropriate.

4.8 Recommended actions include:

(a) Establishment of purpose-oriented water assessments and predictions taking into account the specificity of both surface and ground waters, water quality and water quantity and addressing all pollution types.

(b) Establishment and enhancement of effective flood and drought warning and preparedness systems within the framework of the International Decade for Natural Disaster Reduction.

(c) On a basin scale, or as appropriate on a larger scale, the assessments should be harmonized (station networks, field and laboratory techniques, methodologies and procedures, data handling), leading to basin-wide data systems which should be made accessible to the relevant institutions and to the public. These assessments should be made available through adequate international cooperation within all basin countries.

(d) Training programmes developed throughout the monitoring chain from field activities and laboratory practices to data interpretation, and reporting are a key component from the local to national level. Analytical quality control and inter-laboratory comparisons are needed to ensure proper comparisons within basins and at an international level (e.g. pollutant inputs to seas and oceans). This should be achieved through the creation or enhancement of national or regional reference laboratories and observatories. The establishment of national or regional water quality centres is needed, as well as surveillance centers to evaluate the health of aquatic ecosystems.

(e) New appropriate assessment and prediction techniques and methodologies should be developed and used, such as low-cost field measurements, continuous and automatic monitoring, use of biota and sediment for micro-pollution, remote sensing and geographic information systems.

Water Pollution Prevention and Control

4.9 A water pollution prevention and control strategy should 1) maintain ecosystem integrity through the protection of aquatic resources from negative impacts caused by development and natural processes, 2) protect public health against disease vectors and from pathogens, and 3) ensure sustainable water use and ecosystem protection on a long-term basis.

4.10 In order to slow down the rapid deterioration of water quality and enhance the availability of safe water, by the year 2000 all countries, appropriate to their capacities, the availability of resources

and needs, and with the support of external support agencies, as appropriate, should have in place water pollution control programmes based upon enforceable standards for major point-source discharges, as well as major nonpoint sources of pollution. These should include an inventory of potential sources of water supply leading to the preparation and implementation of programmes for their protection, conservation and sustainable utilization.

4.11 Recommended actions include:

(a) Development and application of rapid assessment procedures for the identification, inventorization and quantification of pollution sources; effluent monitoring; monitoring of acid precipitation; industrial and municipal sector reviews; and agrochemical use verification.

(b) Development of programmes in priority areas of high risk for the restoration and enhancement of degraded aquatic ecosystems, including water courses, lakes and groundwater aquifers.

(c) Promotion of national legislation and regional agreements, where necessary, for preventing and controlling transboundary water pollution.

(d) Through capacity building of regulatory agencies, at all levels, strengthen the enforcement of pollution prevention and control measures.

(e) Where possible, utilize economic instruments, including charges on water users and polluters and appropriate incentives, with the funds generated being utilized for waste water treatment and reinforcement of environmental management activities in freshwater resources.

(f) Development and application of appropriate, low-cost, low-waste industrial production and sewage treatment technology, appropriate technology for the recycling of wastewater, biotechnology for waste treatment and indigenous technologies for water pollution prevention and control.

(g) Establishment of a national surveillance programme for the operation and maintenance of water pollution control installations, with particular attention to high risk zones, with the possible aid of international agencies.

(h) Protection of public health by the development of programmes for the identification and control of disease vectors and pathogens transmitted through freshwater.

Protection of Groundwater

4.12 The extent and severity of contamination of unsaturated zones and aquifers has long been underestimated due to the relative inaccessibility of aquifers and the lack of reliable information on aquifer systems. A strategy for the protection of groundwater must be aimed at protecting aquifers from becoming contaminated and preventative efforts should be directed first at land-use activities and point and nonpoint sources that pose a high-risk of causing pollution. Care must be exercised to avoid groundwater development that leads to the degradation of groundwater quality or the depletion of groundwater supplies. By the year 2000 assessments of known aquifers and their vulnerability to contamination should have commenced in all countries, while potential sources of groundwater pollution should be identified and plans for their control developed. These activities should be matched to the capacities, available resources and needs of countries and undertaken with the help of external support agencies, as appropriate.

4.13 Recommended actions include:

(a) Implementation of mapping programmes for identification of aquifer recharge areas, establishment of national inventories of known groundwater resources and the characterization of aquifers and determination of their responses to groundwater development activities . Such aquifer information will permit water managers to identify recharge and abstraction areas and interactions between surface waters and aquifers and establish controls on the types of activities which take place in these zones.

(b) Identification and control of major pollution sources. These include on-site sewage discharges, active and inactive landfills, mine tailings and mine drainage among others.

(c) Promotion of conservation, environmentally sound cultivation practices, appropriate use of fertilizers and pesticides, and proper management of animal manure and farm effluents to minimize groundwater and surface water contamination.

(d) Prevention of saline intrusion into aquifers through careful management of abstraction rates, and where appropriate artificial recharge.

(e) Encouragement and development of technologies for the promotion of waste minimization, pre-treatment and recycling.

(f) Ensure that resource management and legislation provides for the sustainable management of groundwater, and promote the development of national legislation for protecting groundwater.

Protection of Aquatic Ecosystems and Freshwater Living Resources

4.14 An integrated approach to environmentally sustainable management of the water resources needs to include protection of aquatic ecosystems and freshwater living resources as a central goal. Living resources within aquatic ecosystems should be managed to optimize the benefits for human needs and the long-term sustainability of the ecosystem. By the year 2000 all countries should put in place strategies for the environmentally sound management of their freshwater and associated coastal ecosystems; such strategies should consider fisheries, aquaculture, grazing, agricultural resources and biodiversity. These resources add to the value of water as an economic good and in return provide powerful justification for the protection of these ecosystems. These activities should be undertaken by countries according to their capacities, available resources and needs, and with the support of external support agencies, as appropriate.

4.15 Recommended actions include:

(a) Plan and implement environmentally sound management of aquatic and terrestrial ecosystems including catchment and riparian forests, wetlands, riverine floodplains and associated freshwater and estuarine habitats as integral components of comprehensive water resources development.

(b) Mandate environmental impact assessments for all major projects in basins considering social, health, economic and ecological concerns.

(c) Maintain, and where appropriate, restore or enhance the ecological productivity and diversity of the wetland ecosystems which are important for their social, economic and environmental values.

(d) Contracting parties to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR Convention) are urged to apply its provisions in support of the environmentally protective recommendations identified here and to encourage non-contracting parties to join in the convention.

Summary and Recommendations

4.16 Water should be managed and developed holistically, in view of critical natural connections. This means management on a drainage basin basis, including transboundary basins, to ensure environmental protection and conservation of the natural resources base. Holistic water management means that all uses, including the conservation and sustainable use of living resources, are considered when making water management decisions. This objective will be more likely to be achieved if values, direct and indirect, obvious and intrinsic, are calculated and the true cost of water is paid by the user. The payment of the true cost of water is likely to encourage water conservation, efficiency and reuse. As recognized by the recent Mexico Declaration (1991), efficient water use and the reuse of waste water are the most cost effective and environmentally sound ways to address water-supply needs. The ability to pay of the poor urban and rural people should be considered in pricing water supplies for essential uses.

4.17 A basin approach to water resources planning and management means considering all sources of pollution, point and nonpoint, including acid deposition and the leaching of contaminants from the soil into groundwater. It means addressing the connections between surface water and groundwater. It means considering the relationship between water quality and water quantity, and between upstream and downstream uses. And it means protecting and, as appropriate, restoring the chemical, physical and biological characteristics of water systems.

4.18 Several approaches, tools and mechanisms are recommended to implement holistic basin management. As a general approach, preventing pollution through reduced loadings or better management practices is preferable, both economically and environmentally, to cleaning up water resources after they are fouled. Scientific research, analysis, monitoring, surveillance, predictions and assessments are important tools upon which to rely when making management or development decisions. Environmental, social, health, economic, technical and legal considerations all must be taken into account and applied in an appropriate balance when making management decisions and when implementing them.

4.19 Public information, education and participation are important parts of holistic basin management.

4.20 While many actions are local or provincial in nature, the ultimate impact on the environment is global. Accordingly, national leadership, supported by international co-operation in capacity building, training and technology transfer is important. An assessment of these issues and the global progress on implementing an environmentally sound basin management approach should be made by the year 2000.

4.21 To promote the holistic basin management approach, an action programme for the environmentally sound integrated management of basins should be established. Mechanisms within the United Nations system as a whole, as well as multilateral and bilateral cooperation agencies, should be called upon to support this initiative. Wherever applicable, existing regional bodies should be enlisted in supporting the implementation of the proposed initiative in international basins.

5. WATER AND SUSTAINABLE URBAN DEVELOPMENT AND DRINKING WATER SUPPLY AND SANITATION IN THE URBAN CONTEXT

Introduction

5.1 Urbanization and industrialization linked with rapid population growth have been major engines for national economic growth. These tendencies are expected to continue and, in some countries, to accelerate. Urban domestic and industrial consumers are using even larger shares of available water resources and are, at the same time, degrading these resources with their wastes. Urgent actions are required to improve the effectiveness of use of water resources, if their contribution to human well-being and productivity is to be sustained.

5.2 The Conference endorses three key strategic principles for setting priorities and choice of action programmes for the use and management of water resources:

- Water should be considered an economic good having a value consistent with its most valuable potential use.

- The above principle necessitates new institutional approaches to the management of water resources. Capacity building, especially institutional development, should therefore receive priority attention.

- In the choice of sectoral priorities for action programmes, relatively more attention should be given to the management of wastes (reduction, reuse and recycling, collection, treatment and disposal).

5.3 To prevent exaggerated expectations about the rate of progress which is possible in resolving important issues in implementing the above principles, action programmes should be consistent with realistic appraisal of the resources available to implement them, at the same time the international community should mobilize resources to support the proposed actions.

5.4 Six areas of particular concern are discussed in the following sections.

Institutional/Legal/Management Reforms

5.5 Water resources should be managed at the lowest appropriate level by institutions capable of managing water distribution and demand.

5.6 Urban water and sanitation services need to be integrated with land use, housing and environmental protection. As scarcity increases, water resources have a greater impact on development planning. Urban water resource management should, therefore, be integrated with all aspects of national and regional planning processes affecting the region in which the city is sited.

5.7 Financial viability and autonomy of urban water and sewerage agencies should be encouraged.

5.8 By the year 2000 all countries, appropriate to their capacities, available resources and needs, and with the support of external support agencies, as appropriate, should have arrangements for enforcing water and effluent standards which should reflect the "polluter pays" principle.

5.9 Recommended actions include:

(a) Initiate capacity building programmes to establish institutional and legislative frameworks for water management and pollution protection, especially for integrated water resources planning and land-use management; developing and applying regulatory and economic instruments; and undertaking monitoring and surveillance.

(b) Develop institutional frameworks which bring together water utilities, non-governmental organizations, the private sector and community groups to exchange views, contribute

skills and take decisions on water supply and sanitation projects. Support intersectoral planning involving relevant sectoral agencies at all administrative levels.

(c) Train and retain staff at all levels with skills in community involvement, low-cost technologies, and financial management and for undertaking hygiene education programmes, with a focus on women and children.

(d) Undertake international collaboration and information exchange in support of institutional reforms.

Efficient and Equitable Allocation of Water Resources

5.10 As demand grows and resources diminish, priorities have to be established which balance health improvement, desires for food security, environmental protection and economic growth. The economic, social and environmental priorities to be established should take into account the availability and long term sustainability of water resources ensuring, as a top priority, the availability of sufficient affordable domestic supplies, providing for meeting the basic needs of the very poor, particularly during droughts. Charging for water use is essential, and the full cost of any subsidies (including opportunity cost) should be public knowledge.

5.11 By the year 2000 planning processes should ensure that water resource and development objectives are matched, enabling cities to plan on an assured basis.

5.12 Recommended actions include:

(a) Provide technical and financial support at all levels for assessment and monitoring to help safeguard the availability and quality of surface and groundwater resources and reduce pollution load by sector.

(b) Inform public opinion and encourage Governments to develop priorities according to economic criteria for the allocation of water resources to achieve long term sustainability.

(c) Strengthen institutional capacity especially at the local level and provide technical support for the introduction and application of water charges and pollution penalties which reflect the marginal and opportunity cost of water.

(d) Foster water conservation and recycling through all available means including economic and regulatory incentives and technical devices. Provide incentives for efficient use of water, recycling and pollution reduction.

(e) Make available affordable supplies for meeting the basic needs of the poor who lack services at the present.

Protection Against Depletion and Degradation of Water Resources

5.13 The costs of providing new water are rising rapidly, while protection, conservation and reuse could enable demands to be met much more economically. To achieve economic gains, resources need to be protected, and water charges and pollution penalties have to reflect the true value of water.

5.14 As part of an overall strategy to protect health and the environment and to make the most economic use of all available water resources, present pollution trends should be reversed to progressively improve water quality. In this context, development funding agencies should take the initiative to encourage the incorporation of a significant element of environmental improvement in water related projects.

5.15 Within 10 years, programmes to provide sanitary containment or treatment for at least 50% of the pollution load (biological oxygen demand) from domestic wastes should be initiated. By

2015 every country should have achieved river water quality (varying from location to location) which safeguards supplies for downstream users.

5.16 Recommended actions include:

(a) Use scientifically established guidelines and set objectives for the protection of all river systems and groundwater resources, and translate the objectives into discharge quality and reuse standards for upstream municipal and industrial effluents; implement monitoring programmes, supported by enforced legislation and pricing mechanisms.

(b) Include water consumption and effluent load among the criteria conditioning the choice/approval and location of new industrial sites or expansions thereof and establish standards for effluent quality for existing and new industries.

(c) Improve agricultural, pastoral and forestry practices, including the controlled use of agro-chemicals, to reduce the degradation and depletion of water resources.

(d) Implement national programmes to introduce sanitary waste disposal facilities, based on low-cost improvable technologies, and to ensure that investment in public water supply is accompanied with appropriate investment in the removal, recycling, safe reuse and disposal of municipal wastes and surface water drainage.

(e) Increase environmental awareness through education and public relations campaigns to stimulate behavioural change to conserve water, combat pollution, and increase disaster preparedness.

(f) Enhance cross-sectoral information exchange and applied research on improved recycling techniques, groundwater treatment and protection methods and surface water drainage to abate runoff pollution.

Enhanced Access to Water, Sanitation and Waste Disposal

5.17 Accelerated provision of basic water and sanitation services is a prerequisite for improved health and for sustainable social and economic advancement. The poor put a high priority on the dignity and convenience of clean water and hygienic sanitation, reflected in a proven willingness to pay for reliable services.

5.18 Provision should be made for reliable water, sanitation, solid waste and drainage services to the urban poor, especially women and children, as a priority component of national environmental management strategies, involving the private sector and non-governmental organizations.

5.19 In urban areas, in accordance with national capacities and available resources, and with assistance from external support agencies, as appropriate, water supply and sanitation services should be extended with the aim of reducing the number of lacking services at the end of the International Drinking Water Supply and Sanitation Decade in 1990 to half that number by the year 2000 and to provide coverage for all by 2015.

5.20 Recommended actions include:

(a) Provide international technical and financial support to develop costed proposals (including operation and maintenance) for providing services to the urban poor, and allocate commensurate budgets.

(b) Ensure the use of progressive water tariffs, that reflect the true cost of providing and maintaining supplies, including cost-recovery, and encourage conservation and minimize waste. Ensure charging policies enable the very poor to receive basic services.

(c) Evaluate the scope for rehabilitating existing malfunctioning systems as an alternative to investing in new projects. Ensure the technical, institutional and budgetary requirements for future operation and maintenance are provided for in the planning, design and implementation phases of new projects. Establish preventive maintenance schedules, leak detection programmes, and regular quality surveillance. Develop guidelines and monitor the achievement of sustainable water and sanitation services.

(d) Encourage local water associations and water committees to manage community water supply and sanitation systems.

(e) Develop reduced-cost sewerage systems for low-income settlements and make low-cost water supply and sanitation technology choices available in all countries.

Health Impacts from Urban Water Resource Management

5.21 Contaminated and unreliable water supplies pose high risks of a variety of preventable communicable diseases. Medium and long-term plans for environmental sanitation should be established by 1995 to ensure permanent protection of vulnerable groups against disease risks, especially cholera. Consideration should be given to the creation of an international fund to respond to health hazard emergencies.

5.22 Recommended actions include:

(a) Provide international technical and financial support for the design and implementation of water supply and sanitation programmes to develop national inventories and address environmental health issues of vulnerable groups.

(b) Strengthen the monitoring and reconnaissance capabilities of water authorities to identify health risks, including those arising from the gathering of people, and to implement multisectoral rapid response interventions, such as those dealing with epidemics.

(c) Develop policies and an international clearing house for information, education and communications. Promote public education on improved domestic disinfection systems suitable for use with low-cost water supply and sanitation technologies, involving the participation of grass-root organizations.

Resource Mobilization

5.23 Unless the twin problems of water scarcity and pollution are tackled urgently and effectively, the cost of water will become an overriding constraint on national economic growth. Investments in urban water and waste management should be commensurate with the major contributions cities make to economic growth.

5.24 The willingness of unserved populations to contribute should be harnessed to invest in reliable services. Tariffs should be employed to ensure adequate cost recovery for upkeep and extension of services.

5.25 Recommended actions include:

(a) Undertake a global programme to promote public information and communication campaigns to mobilize support for achieving sustainable urban development, emphasizing the extent to which this is threatened by current trends. There is a need for realistic pricing, and for increased investment in water resource protection and pollution prevention.

(b) Provide technical support and build capacities to ensure financial viability, community involvement and decision making, including the participation of women, in investments, reducing unaccounted-for water and taking full advantage of recycling opportunities in municipal waste water and solid waste disposal.

(c) Undertake applied research to extend economic evaluation techniques to include environmental considerations in full.

6. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT AND DRINKING WATER SUPPLY AND SANITATION IN THE RURAL CONTEXT

Introduction

6.1 For many developing countries, agriculture remains the dominant economic sector and the majority of their population are rural. While the rural population will grow in absolute terms, it will not only have to meet its own rising food requirements; additionally it will have to feed a rapidly increasing urban population. Meeting the basic needs of the rural populations, namely: drinking water, food, shelter, clothing, sanitation and primary health care, and the environmentally sustainable transformation of the subsistence agriculture to a productive and economically viable venture is the basis of rural development.

Principles

6.2 The key strategic principles for holistic and integrated environmentally sound management of water resources in the rural context are:

(a) Water should be regarded as a finite resource that has an economic value with significant social implications.

(b) Local communities must participate in all phases of water management ensuring the full involvement of women in view of their crucial role in the practical day to day supply, management and use of water.

(c) Water resource management must be developed within a comprehensive set of policies for human health; food production, preservation and distribution; disaster mitigation plans; environmental protection and conservation of the natural resource base.

(d) The need to recognize and actively support the role of rural populations with particular emphasis on women, given their role in feeding the world's population and protecting its environment.

Integrated Rural Water Management

6.3 In order to meet the basic needs of the rural populations, water development and management will have to be considered in an integrated manner. This integrated approach has to consider sustainable development programmes, including institutional and human resources development, protection of the environment and preservation of feed and food supplies.

Legislation and Institutional Arrangements

6.4 The adoption of more efficient water use, protection of water quality from pollution by agricultural chemicals and other contaminating materials, and establishment of clearly defined property rights and obligations require the introduction of appropriate legal instruments at local and national levels. Given the need to address multi-sectoral problems related to water use at the rural level, inter-institutional linkages will need to be established. Strengthening the capacity of institutions to administer the legal, economic and monitoring functions is essential.

Issues and Strategies

Efficient and Rational Allocation of Water: Quality and Quantity

6.5 A major part of the available freshwater,in the future, will be taken up to supplement rainfall for agricultural production. This is to meet the needs for food, fuel, fodder and fibre and timber of a rapidly growing population, especially in the developing countries. At the same time, the demands for good quality water for drinking and sanitation and for industrial use are rising sharply,

especially in the rapidly growing urban areas. Safeguarding good quality water is moreover necessary for fisheries and aquaculture, the maintenance of valuable natural ecosystems and environmental protection in general.

6.6 This combination of increasing demands on finite freshwater resources make them ever scarcer. It calls for a more efficient use of resources, specially in the agricultural sector, and a rational allocation between the various demand sectors. The main strategies should ensure that water users realize the scarcity value of the resource and incentives to promote this must be established. Measures would include demand management in the form of charging systems for efficient and just use of water; cost recovery policies to provide secure sustained efficient operations and maintenance of water supply systems; education and public information programmes; and legal entitlements for access to water resources. Such measures will have to be introduced with due consideration of the cultural, social and ecological values of water. Simultaneously priority should be given to meeting the basic needs of the poor, including drinking water and small scale agriculture. Prerequisites to resolving the competing demands are: comprehensive resource inventory and evaluation of existing land and water needs; the promotion of water storage and saving devices; and sound water use at watershed and village levels.

6.7 — The quality of freshwater is declining in many parts of the world due to human induced land degradation, salinization, and pollution by chemical compounds and elements. The main strategy to combat this is arresting this problem at its sources, through incentives and regulations for environmentally sound soil and water conservation measures. Close monitoring of all waste disposals and contaminations is required as well as application of appropriate legal and administrative controls and the establishment of requirements for polluters to cover the cost of recovery of the water quality. To prevent losses in quantity and quality of agricultural produce, and protect human health, water quality standards for agricultural, drinking and sanitation uses should be set and appropriate mechanisms put in place for their effective implementation.

Water for Sustainable Agriculture

6.8 In many parts of the world, water use efficiencies are low both at irrigation scheme and at farm level. This has been the primary cause of waterlogging and salinization of irrigated lands, water losses, water-borne diseases and environmental degradation. The major strategies consist of: introduction of cost recovery mechanisms; demand management; close monitoring of irrigation system performance and water management at the field level; improvement to irrigation and on-farm infrastructures; and promotion of adaptive technological research and development as well as the dissemination of results. Additionally, irrigation institutions including water users associations will have to be strengthened.

6.9 Flooding, lack of adequate drainage, poor operation and maintenance of irrigation schemes, and inefficient water applications at the farm level have contributed to surface water stagnation, waterlogging and salinization of many irrigated lands and low-lying areas. They have resulted in not only loss in productivity of agricultural lands but also deterioration of the environment. The primary strategy consists of the reduction of the sources of excess water and provision of artificial drainage in existing wet croplands when necessary. It should be re-inforced by the introduction of efficient pricing and cost recovery mechanisms. Flood and rain waters causing temporary ponding on extensive plains can be contained for subsequent dry-season crop growth.

6.10 Improvement of rainfed agriculture by small-scale water programmes including collective well irrigation systems, small reservoir or tank irrigation schemes, multipurpose water harvesting projects, village drinking water supply and community garden programmes can fulfil many rural community needs and are sustainable. This may include diverting and storing of temporary excesses of rain waters and their subsequent use. The primary strategy consists of providing incentives, technical and institutional support to local communities to develop and manage water resources to meet their multiple needs.

6.11 Flood recession agriculture is a primary source of food supply on many major flood plains, its value in meeting the basic needs of the rural poor should therefore be given special recognition

when considering management of basin resources. Due consideration should be given to maintaining minimum water flows downstream when designing water management schemes.

6.12 Lack of good quality water limits livestock production under grazing and rangeland conditions. Solutions call for integrated land and water use strategies for the semi-arid areas to be developed in close cooperation with pastoralist populations and based on clearly defined property rights. The strategy consists of providing appropriately spaced and reliable watering points and grazing lands within sustainable land use systems. Livestock production is also the cause of water contamination because of improper waste management in high livestock density zones. Leaching into aquifers is to be reduced through better integration of livestock and crop production. Where livestock is one among competing users of a limited water supply, the opportunity value of the water in question must be established to assist in determining the efficient and equitable allocation of water.

6.13 Inland water fisheries should be managed to optimize the yield of aquatic food organisms through conservation of water quality and quantity and functional morphology of inland aquatic systems. Aquaculture should be promoted as a component of integrated farming systems. At the same time, aquaculture development and coastal fisheries will need to be guided to protect the quality of aquatic systems and the environment. The major strategy consists of promoting inland fisheries and aquaculture within the framework of national and international water resources planning and management. In the context of competing uses for water the opportunity value should be applied as in the case of water for livestock.

Providing Water Supply and Sanitation for the Unserved Rural Poor

6.14 Quite a significant rural population remains without reasonable access to safe drinking water and sanitation at the end of the International Drinking Water Supply and Sanitation Decade. There is a need to find means of encouraging rural communities to undertake local development initiatives with the resources available to them. The major strategies are: establishing national policies and budget priorities with regard to increasing service coverage; promoting appropriate technologies; introduction of suitable cost recovery mechanisms, taking into account efficiency and equity through demand management mechanisms; promoting community ownership and rights to water supply and sanitation facilities; and establishing monitoring and evaluation systems.

6.15 Insufficient funds, insufficient trained manpower, poor operation and maintenance of systems and lack of community participation were identified as constraints to sustainable water supply and sanitation services in rural areas. Lack of knowledge on health consequences of unhygienic services contributes to poor performance of water supply and sanitation systems after commissioning. The major strategy consists of strengthening the rural water supply and sanitation sector with emphasis on institutional development, efficient management and an appropriate framework for financing of the services.

6.16 Inadequate water supply and sanitation often results in a broad range of health problems including diarrhoea, schistosomiasis, and guinea worm infection. In addition, inappropriate water storage in and around houses and village ponds and irrigation and drainage canals may serve as breeding sites of vector mosquitoes that cause dengue and malaria. The strategy consists of hygiene education and elimination of transmission foci; adoption of appropriate technologies for water treatment; and wide-scale adoption of environmental management measures to control disease vectors.

Capacity Building

6.17 There is an urgent need for developing nations to build their own long-term capacities for integrated management of rural resources that support their communities. The major strategy consists of the creation of policy and legal frameworks, the development and strengthening of institutions, the dissemination of hydrological and other data bases, the promotion of community participation and the training of human resources, all on a continuing basis.

6.18 The actions at local, provincial, national and international levels will require an institutional framework, mechanisms for coordination within a country and between countries and the United Nations system of organizations and donor and financing agencies.

Actions required to meet the challenges

6.19 According to one set of projections the global population is expected to reach 8 billion by the year 2020. The consequent dramatic growth in food demand and the pressures upon the natural resource base pose an enormous challenge to the rural sector. The latter will not only have to substantially increase food production, but being the major user of water resources, it will have to release freshwater resources to meet increasing demands for domestic, industrial and ecosystem management purposes. Additionally the rural sector will have to significantly contribute to the conservation of the natural resource base.

6.20 Recommended actions include:

(a) Strengthen national capacities to plan, implement, and monitor integrated water management programmes. The major strategy is to create policy and legal frameworks on a participatory basis, as well as develop and strengthen institutions at all levels. This should be accomplished with emphasis on community participation and human resource development taking into consideration the full involvement of women who constitute a substantial number of the world farmers.

(b) Resolve competing demands on water resources through the application of appropriate economic, legal and institutional mechanisms. This objective is achievable through: better integration of water use within the framework of overall national economic, agricultural and environmental policies and adoption of demand management strategies ranging from appropriate pricing policies to implementation of relevant legal frameworks and entitlements supported by the widespread introduction of water saving technologies.

(c) Promote and actively support water conservation and water use efficiency in agriculture with the objective of making more water available for domestic and industrial use as well as for ecosystem management.

(d) Actively promote the use of participatory mechanisms for involving communities, with emphasis on the role of women, in the planning and implementation of programmes for agricultural water use, water conservation, and water supply and sanitation.

(e) Introduce and actively use baseline assessments, selection of readily measurable indicators, effective monitoring mechanisms during project implementation and evaluation of achievements against set objectives.

(f) Meet the food needs of 8 billion people by 2020 through substantial increase of efficiency of water use in existing irrigation schemes, maximize water conservation in new irrigation schemes and improve drainage in wet and saline croplands. Increased water use efficiencies must additionally be sought in rainfed agriculture through effective measures including flood management and drought mitigation. The enhancement of food delivery by the rural sector should be complemented by other measures including widespread introduction of drought resistant crops, insect and rodent control, effective storage and transportation.

(g) — Activate mechanisms to provide rural populations with better access to essential technical and environmental information, in order strengthen their role in decision making processes.

(h) Adjust agricultural land use practices and improve rural sanitation and community and industrial waste disposal to improve the protection of ground water and surface water including coastal seas.

(i) Implement on a large scale appropriate mechanisms for sustainable service coverage of water supply and sanitation developed during the International Drinking Water Supply and Sanitation Decade to provide universal access.

(j) Include considerations of health consequences in all water resource programmes in order to enhance social and economic development.

(k) Ensure that by the year 2000 all countries and rural communities according to their capacities and available resources and with assistance from external support agencies as appropriate will:

(i) Have agricultural and water resources systems so that through local production and commodity trading, they will have access to sufficient food to meet their basic nutritional needs.

(ii) Have access to safe water in sufficient quantities and adequate sanitation to meet their health needs and maintain the essential qualities of their local environments.

(iii) Develop their water resource systems only as components of comprehensive integrated programmes designed to provide for long term sustainment of human welfare and the careful management of natural ecosystems

7. MECHANISMS FOR IMPLEMENTATION AND CO-ORDINATION AT INTERNATIONAL, NATIONAL AND LOCAL LEVELS

Appropriate levels of management

7.1 Centralized and sectoral (top down) approaches to water resources development and management have often proved insufficient to solve local water management problems. The role of governments needs to change to ensure a more active participation of people and local institutions, public and private. The levels at which effective management decisions can be taken and problems can be solved vary from country to country, as do the relative roles of institutions in the administrative (socio-political) and hydrological (catchment/river basin) structures. The fundamental principle remains however that, in any given situation, water resources should be managed at the lowest appropriate levels. The need for integration of sustainable water management with land use management, preservation of the environment and the reconciliation with other sector interests has to be recognized. In particular, the needs of human settlements, agriculture and industry have to be managed and based on a balanced consideration of the total needs of people and the environment.

Mechanisms at the national level

7.2 While the principle of the management of the resource at the lowest appropriate level requires a decentralized approach to water management, such an approach would fail if it were to operate in an institutional vacuum. There is a need for institutional arrangements at the national level, such as a national water authority, capable of defining priorities, policy directions, targets and, where appropriate, prescribing standards. The term "authority" is used in this context to reflect its function of facilitating the implementation of water resources development and conservation activities and a system of checks and balances to safeguard public and national interests and to promote improved management.

7.3 The most pivotal and complex function of a national authority lies in the establishment of effective integration of the overall socio-economic and environmental decision-making process with the formulation of water resources policies and programmes. Similar linkages are required in order to conserve ecosystems and development needs on a sustainable basis. Such an authority may also provide an enabling environment for local resource mobilization and the flow of financial resources and the co-ordination of external support. Other functions of a national authority could be concerned with the co-ordination and management of data, including national monitoring networks, the formulation of a regulatory framework, the facilitation of technology transfer, the support of human resources development, the promotion of sustainable water management and full public participation in all aspects of water.

7.4 The national authority provides the necessary support for river and lake basin authorities or committees with responsibility for the integrated management of the water resources in the basin. At the very least, a central authority needs to provide a system of linkages between existing organizations dealing with water resources, with a view to harmonizing approaches and policies. In the case of federated countries, parallel state or provincial authorities may be needed to perform related functions falling under the jurisdiction of states or provinces.

7.5 Recommended actions to include:

(a) Assess current organizational arrangements as part of national action plans for sustainable development.

(b) Establish and strengthen national water authorities and river basin entities as required.

(c) Support and strengthen further development of water legislation and institutional mechanisms for the co-ordinated management of water resources to ensure sustainable development.

Transboundary basins

7.6 The most appropriate geographical entity for the planning and management of water resources is the basin, including its surface water and groundwater. Ideally, the effective integrated planning and development of transboundary river or lake basins has similar institutional requirements as in the case of a basin entirely within one country and should be based on the same principles. The essential function of existing international basin organizations is one of reconciling and harmonizing the interests of riparian countries, monitoring water quantity and quality, development of concerted action programmes, exchange of information, and enforcing agreements. As regards transboundary groundwater basins, exploitation of such aquifers should take into account the safe yield of the live aquifers while developing principles for the control of pollution.

7.7 Recommended actions to be taken by Governments include:

(a) Evaluate the experience gained with existing transboundary basin water authorities, committees and commissions.

(b) Support the further development of legal principles and institutional mechanisms for the co-ordination of water management within transboundary basins.

(c) Promote the co-operation of riparian countries within a transboundary basin in the establishment of appropriate legal, institutional and operational mechanisms.

International implementation mechanisms

7.8 Regional and global dimensions of water problems are rapidly growing in importance. Water resources are coming under increasing stress with the growth of populations, while water is now recognized as the central component of global ecosystems and of the climate system. This requires the strengthening and development of a framework for the formulation of international water-related monitoring, programmes, policies and strategies. Such a framework must ensure that water problems are considered in the wider context of environmental and sustainable development issues.

7.9 Recommended actions include:

(a) Existing regional mechanisms of a continental and sub-continental scale should be strengthened to harmonize policies, strategies and programmes, and similar mechanisms should be implemented in other regions as well, as needs arise.

(b) Co-operation on a regional basis for the exchange of experience in the protection and use of transboundary waters, including legal mechanisms and institutions should be promoted.

(c) Functions and capacities of intergovernmental bodies should be reviewed, including United Nations institutions, regional and sub-regional organizations and non-governmental organizations; identify key needs not adequately addressed by these bodies; and make concrete proposals for strengthening intergovernmental bodies and further improving co-ordination with member states.

(d) The United Nations Conference on Environment and Development and its Earth Charter should reflect the principles required for development, use, conservation and protection of water resources and aquatic ecosystems especially in their international aspects.

(e) Adequate international exchange of data on the components of the water cycle in terms of quantity and quality should be promoted, through established international programmes for such exchange and the use of international data centres, and supported by regulations under international law specifying mutual obligations and rules of procedure.

(f) Countries should ensure that effective flood and drought warning and preparedness systems are part of national sustainable development plans, within the framework of the International Decade for Natural Disaster Reduction.

(g) International co-operation should be strengthened to expand national financing of environmentally sound and socially responsible water activities.

Global co-ordination

7.10 At present, international arrangements are lacking for the effective co-ordination of global freshwater activities by multilateral, bilateral, and non-governmental organizations. A major problem is the lack of linkages between the community of external support agencies, governments and non-governmental organizations which deal with water resources co-ordination and facilitation.

7.11 Suitable arrangements should address the following key needs:

- raising the global profile of freshwater issues and maintaining that profile in the period after the United Nations Conference on Environment and Development, with a view to ensuring sustained global commitment to addressing freshwater problems;

- improving opportunities for co-ordination of water programmes, particularly those of the external support agencies (bilateral and multilateral);

- providing a forum to encourage dialogue and confidence-building measures regarding transboundary issues among riparian countries;

- facilitating discussions and the development of recommendations, based on shared experience in areas related to water management, such as legislation, research and development, and technology transfer;

- reviewing progress in the implementation of the freshwater programme areas of Agenda 21.

7.12 The following specific actions are recommended:

(a) Strengthening United Nations institutions such as the ECOSOC Committee on Natural Resources and enhancing interagency co-ordination through mechanisms such as the Intersecretariat Group for Water Resources;

(b) Supporting the establishment of a facilitating mechanism, such as a world water forum or council, by which water specialists in various constituencies such as governments, international bodies, non-governmental organizations and private sector bodies could co-operate.

8. OPTIONS FOR FOLLOW-UP

8.1 A number of recommendations to improve management of water in an environmental context and as a key element of sustainable development have been made in the earlier sections of this report. These recommendations and the analysis will go forward to the Preparatory Committee for the United Nations Conference on Environment and Development (UNCED), the Earth Summit, in Rio de Janeiro, June 1992. The UNCED preparatory process has already developed a draft programme on water and environment which will be modified in the light of the Dublin Statement and Conference Report. The Earth Charter and Agenda 21 which will be discussed at UNCED (often described as the Earth Summit) will contain a number of calls for action on water and environment at national, regional and international levels.

8.2 Experience with the Mar del Plata Action Plan (UN Water Conference, 1977) has shown that procedures and mechanisms for follow-up to ensure progress on the required action are essential to achieve the defined goals. The Dublin Conference urges that UNCED ensures a strong follow-up process for all matters covered by Agenda 21.

8.3 Unlike many other sectors, there is no global intergovernmental organization that could be logically charged with taking a comprehensive overview of progress on water-related aspects of Agenda 21. With this in mind the Dublin Conference considered possibilities for an UNCED water follow-up. The first need is to strengthen existing United Nations institutions, such as the Committee on Natural Resources of ECOSOC and the Intersecretariat Group for Water Resources. However, neither mechanism provides for involvement of all interested governments together with private sector groups, so important in water management issues. In addition to strengthening United Nations bodies and to provide for a wider sector involvement, one option is the establishment of a more comprehensive world water forum or council, similar to the existing Collaborative Council on Water Supply and Sanitation, to which governments, international and regional bodies, non-governmental organizations and private sector bodies could adhere.

8.4 Which of these options or other mechanisms are adopted by UNCED depends to a considerable extent on the more general follow-up mechanisms adopted by the Earth Summit. The Dublin Conference urges that any such follow-up mechanisms or arrangements provide specifically for appropriate periodic reviews by a competent body of progress on water-related issues of Agenda 21.

8.5 At the national level, governments are urged to consider after the United Nations Conference on Environment and Development assigning to an appropriate national body the task of following the implementation and reviewing progress on the water-related issues of Agenda 21. Such bodies should work in close collaboration with external support agencies operating in the countries.

8.6 At both national and international levels the first major assessment to identify progress in water-related issues should be undertaken by the year 2000.

8.7 The Conference recognizes the need for mobilizing resources from all sources for the vital work outlined in its report and urges UNCED to ensure that the water-related issues are taken into consideration in funding the implementation of Agenda 21.

8.8 The Conference participants urge all governments to study carefully the above recommendations and to translate them into urgent action programmes for WATER AND SUSTAINABLE DEVELOPMENT.

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IMEVBORE, Mr. A.M.A.	NIGERIA
OKEKE, Ms. E.	NIGERIA
SHAIB, Mr. Bukar	NIGERIA
UDOEKA, Mr. E.D.	NIGERIA
WADIBIA-ANYANWU, Mrs. N.U.O.	NIGERIA
BENDIKSEN, Ms. R.	NORWAY
EIDHEIM, Ms. I.	NORWAY
HANSEN, Mr. S.	NORWAY
MCNEILL, Mr. D.	NORWAY
TOLLAN, Mr. A.	NORWAY
WANGEN, Mr. G.	NORWAY
AL-HARTHY, Mr. S.S.	OMAN
AL-SAID, Mr. B.	OMAN
AL-SHAIKH, Mr. J.	OMAN
AL-SHAQSI, Mr. S.R.	OMAN
QAISER, Mr. G.	PAKISTAN
CANDANEDO, Ms. C.	PANAMA
DOUGLAS, Mr. J.	PAPUA NEW GUINEA
FRAGANO , Sr. F	PARAGUAY
SANCHEZ GUFFANTI, Mr. G.	PARAGUAY
VENTURA NAPA, Mr. M.	PERU
SOSA, Mr. L.	PHILIPPINES
KINDLER, Mr. J.	POLAND
ZIELINSKI, Mr. J.	POLAND
ALMIRO DO VALE, Mr. F..	PORTUGAL
BASTOS, Mr. J.P.	PORTUGAL
BORREGO, Mr. C.	PORTUGAL
CANDIDO, Mr. A.	PORTUGAL
CAVALO, Mr. A.	PORTUGAL
ESPIRITO SANTO, Ms.. F	PORTUGAL
GOUVEIA Ms. T	PORTUGAL
LEMOS, Mr. P.	PORTUGAL
MENDES, Mr. A.	PORTUGAL
PASSARO, Mr. M.C.	PORTUGAL
PIRES, Mr. A.	PORTUGAL
RAMOS, Ms. L.	PORTUGAL
SERBAN, Mr. P.	ROMANIA
DA CONCEICAO, Mr. J.	SAO TOME AND PRINCIPE
ABDULRAZZAK, Mr. M.	SAUDI ARABIA
AL HARATANI, Mr. E.	SAUDI ARABIA
AL KALTHAM, Mr. M.	SAUDI ARABIA
AL-AZZAZ, Mr. A.	SAUDI ARABIA
AL-SAATI, Mr. Adnan J.	SAUDI ARABIA
AL-SAHLI, Mr. M.J.	SAUDI ARABIA
ALMAZIAD, Mr. A.	SAUDI ARABIA
HADDAD, Mr. A.	SAUDI ARABIA
FALL, Mr. C.	SENEGAL
SYLLA, Mr. D.C.	SENEGAL
MASCARENHAS, Mr. J.P.	SEYCHELLES
ONG, Mr. H.S.	SINGAPORE
TAN, Mr. L.	SINGAPORE
FERNÅNDEZ, Mr. M.A.	SPAIN
MINGO MAGRO, Mr. J.	SPAIN
WIJESINGHE, Mr. M.W.P.	SRI LANKA

CUMMINGS, Mr. D.	ST. VINCENT & THE GRENADINES
ELHAG, Mr. M.E.E.	SUDAN
HIDAYTALLA, Mr. A.	SUDAN
MOHAMED, Mr. T.A.	SUDAN
NOUR, Mr. M.E.M.	SUDAN
ANDERSSON, Mr. I.	SWEDEN
BJORKLUND, Ms. G.	SWEDEN
FALKENMARK, Ms. M.	SWEDEN
EMMENEGGER, Mr. C.	SWITZERLAND
FLURY, Mr. M.	SWITZERLAND
GOETZ, Mr. A.	SWITZERLAND
LAZZAROTTO, Mr. S.	SWITZERLAND
MUSY, Mr. A.	SWITZERLAND
SPREAFICO, Mr. M.	SWITZERLAND
HADID, Mr. B.	SYRIAN ARAB REPUBLIC
BUDDHAPALIT, Mr. A.	THAILAND
CHINDASANGUAN, Mr. C.	THAILAND
HUNGSPREUG, Mr. S.	THAILAND
HORCHANI, Mr. A.	TUNISIA
BOZKURT, Mr. S.	TURKEY
KULELI, Ms. S.	TURKEY
KULGA, Mr. D.	TURKEY
NUMANOGLU, Ms. N.	TURKEY
SOLEN, Mr. A.	TURKEY
SAKAIO, Mr. V.P.	TUVALU
BOMUKAMA, Mr. S.	UGANDA
KAGIMU, Mr. G.M.	UGANDA
KAHANGIRE, Mr. P.	UGANDA
ODUL, Mr. J.	UGANDA
COCKING, Mr. J.	UNITED KINGDOM
EVANS, Mr. T.	UNITED KINGDOM
FRAMPTON, Mr. R.	UNITED KINGDOM
KIRBY, Ms. C.	UNITED KINGDOM
PARKS, Ms. Y.	UNITED KINGDOM
PIKE, Mr. T.	UNITED KINGDOM
REINA, Mr. P.	UNITED KINGDOM
RODDA, Mr. D.	UNITED KINGDOM
SHERRIFF, Mr. J.	UNITED KINGDOM
SIMCOCK, Mr. A.	UNITED KINGDOM
WILKINSON, Mr. W.	UNITED KINGDOM
MSUYA, Mr. M.O.	UNITED REPUBLIC OF TANZANIA
AUSTIN, Mr. J.	UNITED STATES OF AMERICA
DICKEY, Mr. G.	UNITED STATES OF AMERICA
MOODY, Mr. D.	UNITED STATES OF AMERICA
RANDALL, Mr. B.	UNITED STATES OF AMERICA
ROGERS, Mr. P.	UNITED STATES OF AMERICA
SCHIFFERDECKER, Mr. A.	UNITED STATES OF AMERICA
STALLINGS, Mr. E.	UNITED STATES OF AMERICA
STEEVER, Mr. Z.	UNITED STATES OF AMERICA
WALKER, Mr. C.	UNITED STATES OF AMERICA
WILCHER, Ms. L.	UNITED STATES OF AMERICA
ARDUINO, Mr. G.	URUGUAY
GRACERAS, Mr. C.	URUGUAY
RODRIGUEZ, Mr. M.	URUGUAY
SERRENTINO, Mr. C.	URUGUAY
GONZALEZ, Mr. C.	VENEZUELA
VU VAN TUAN, Mr.	VIETNAM
AL-FUSAIL, Mr. A.K.	YEMEN
MOHAMED, Mr. N.	YEMEN
RADOJICIC, Mr. L.	YUGOSLAVIA
MBEWE, Mr. J.J.	ZAMBIA
MBUMWAE, Mr. L.L.	ZAMBIA

2. REPRESENTATIVES OF BODIES AND AGENCIES OF THE UN SYSTEM

KOKINE, Mr. M.	Economic Commission for Europe (ECE)
LEE, Mr. T.	Economic Commission for Latin America and the Caribbean (ECLAC)
ERTUNA, Mr. C.	Economic and Social Commission for Asia and the Pacific (ESCAP)
RADJAI, Mr. A.	Economic and Social Commission for Western Asia (ESCWA)
BURCHI, Mr. S.	Food and Agriculture Organization of the United Nations (FAO)
DE HAEN, Mr. H.	Food and Agriculture Organization of the United Nations (FAO)
KANDIAH, Mr. A.	Food and Agriculture Organization of the United Nations (FAO)
KAPETSKY, Mr. J.	Food and Agriculture Organization of the United Nations (FAO)
RUBERY, Mr. N.	Food and Agriculture Organization of the United Nations (FAO)
RYDZEWSKI Mr. J	Food and Agriculture Organization of the United Nations (FAO)
SAOUMA, Mr. E.	Food and Agriculture Organization of the United Nations (FAO)
SCOTT, Mr. S.	Food and Agriculture Organization of the United Nations (FAO)
SOMBROEK, Mr. A.	Food and Agriculture Organization of the United Nations (FAO)
STRINGER, Mr. R.	Food and Agriculture Organization of the United Nations (FAO)
TOROS Mr. H	Food and Agriculture Organization of the United Nations (FAO)
BULAJICH, Ms. B.	International Research and TrainingInstitute for the Advancement of Women (INSTRAW)
SHIELDS, Ms. M.	International. Research and Training Institute for the Advancement of Women (INSTRAW)
CRIJNS, Mr. M.J.	International Atomic Energy Agency (IAEA)
YURTSEVER, Mr. Y.	International Atomic Energy Agency (IAEA)
RODDA, Ms .A.	Non-Governmental Liaison Service (NGLS)
DIALLO, Mr. I. K.	Organization of African Unity (OAU)
VLACHOS, Mr. E.	United Nations
DZIKUS, Mr. A	United National Center for Human Settlement UNCHS HABITAT)
RAMACHANDRAN Mr. A.	United National Center for Human Settlement (UNCHS HABITAT)
SINNATAMBY, Mr. G.	United National Center for Human Settlement (UNCHS HABITAT)
SWAN, Mr. P.	United National Center for Human Settlement (UNCHS HABITAT)
DE ROOY, Mr. C	United Nations Children's Fund (UNICEF)
GLATTBACH, Mr. J.	United Nations Children's Fund (UNICEF)
JOLLY, Mr. R.	United Nations Children's Fund (UNICEF)
McLOUGHNEY, Mr. E.	United Nations Children's Fund (UNICEF)
ROSENHALL, Mr. L.	United Nations Children's Fund (UNICEF)
HELMER, Mr. R.	United Nations Conference on Environment and Development (UNCED)
STEADY, Ms. F.C.	United Nations Conference on Environment and Development (UNCED)
WHEELER, Mr. J.	United Nations Conference on Environment and Development (UNCED)
NAJLIS, Mr. P.	United Nations Dept. of Int. Economic and Social Affairs (UNDIESA)
APPLETON, Mr. B.	United Nations Department. of Technical Co-operation for Development (UNDTCD)

EDWARDS, Ms. K.A.	United Nations Department of Technical Co-operation for Development (UNDTCD)
PASTIZZI-FERENCIC, Ms. D.	United Nations Department. of Technical Co-operation for Development (UNDTCD)
LING MAUNG SAN, Mr.	United Nations Department. of Technical Co-operation for Development (UNDTCD)
SAUVEPLANE, Mr. C.	United Nations Department. of Technical Co-operation for Development (UNDTCD)
SOLANES, Mr. M.	United Nations Department. of Technical Co-operation for Development (UNDTCD)
VLACHOS, Mr. E.	United Nations Department. of Technical Co-operation for Development (UNDTCD)
DE GALA, Ms. M.	United Nations Development Programme (UNDP)
GORRE-DALE, Ms. E.	United Nations Development Programme (UNDP)
HARTVELT, Mr. F	United Nations Development Programme (UNDP)
HELLAND-HANSEN, Mr. E.	United Nations Development Programme (UNDP)
KAKONGE, Mr. J.	United Nations Development Programme (UNDP)
LOWES, Mr. P.	United Nations Development Programme (UNDP)
OKUN, Mr. D.	United Nations Development Programme (UNDP)
RAJESWARY, Ms. I.	United Nations Development Programme (UNDP)
NEMEC, Mr. J.	United Nations Disaster Relief Co-ordinator, Office of the (UNDRO) and International Decade for Natural Disaster Reduction (IDNDR)
AURELI, Ms. A.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
BASTIDE, Ms. M.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
DUMITRESCU, Mr. S	United Nations Educational, Scientific and Cultural Organization (UNESCO)
GLADWELL, Mr. J.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
SCHETSELAAR, Mr. E.M.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
SZOLLOSI-NAGY, Mr. A.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
TATIT-HOLTZ, Mr. A.C.	United Nations Educational, Scientific and Cultural Organization (UNESCO)
BISWAS, Mr. A.	United Nations Environment Programme (UNEP)
EL-HABR, Mr. H.	United Nations Environment Programme (UNEP)
GOLUBEV, Mr. G	United Nations Environment Programme (UNEP)
ILLUECA, Mr. J.	United Nations Environment Programme (UNEP)
MAGEED, Mr. Y.A.	United Nations Environment Programme (UNEP)
TOLBA, Mr. M.	United Nations Environment Programme (UNEP)
VANDEWEERD, Ms.V.	United Nations Environment Programme (UNEP)
WHITE, Mr. G.	United Nations Environment Programme (UNEP)
CHOSSUDOVSKY, Mr. E.M.	United Nations Institute for Training and Research (UNITAR)
JHA, Ms. V.	United Nations Research Institute for Social Development (UNRISD)
DE WETTE, Mr. J.	United Nations Information Centre (UNIC)
OERUM, Mr. T.	United Nations Sudano-Sahelian Office (UNSO)
CATLEY-CARLSON, Ms. M.	Water Supply and Sanitation Collaborative Council (WSS)
LOCKE, Mr. B.	Water Supply and Sanitation Collaborative Council (WSS)
VAN DAMME, Mr. H.	Water Supply and Sanitation Collaborative Council (WSS)
WIRASINHA, Mr. R.	Water Supply and Sanitation Collaborative Council (WSS)
BRISCOE, Mr. J.	World Bank (WB)
DELLI-PRISCOLI, Mr. J.	World Bank (WB)
ELAHI, Mr. A.M.	World Bank (WB)
EVANS, Mr. T.	World Bank (WB)
FEDER, Mr. G.	World Bank (WB)
GARN, Mr. M.H.	World Bank (WB)
KUFFNER, Mr. U.	World Bank (WB)
LE MOIGNE, Mr. G.	World Bank (WB)
MATTHEWS, Mr. G.	World Bank (WB)
MONOSOWSKI, Ms. E.	World Bank (WB)
ROTIVAL, Mr. A.	World Bank (WB)
FENGER, Mr. B.	World Health Organization (WHO)

FRASER, Mr. A.	World Health Organization (WHO)
MEYBECK, Mr. M.	World Health Organization (WHO)
WARNER, Mr. D.	World Health Organization (WHO)
WONG, Mr. P.	World Health Organization (WHO)
ASKEW, Mr. A.	World Meteorological Organization (WMO)
BURNS, Mrs. M.	World Meteorological Organization (WMO)
DAR-ZIV, Ms. E.	World Meteorological Organization (WMO)
DENGO, Mr. M.	World Meteorological Organization (WMO)
ESPEJO, Mrs. C.	World Meteorological Organization (WMO)
KRAEMER, Mr. D.	World Meteorological Organization (WMO)
MELDER, Mr. O.-M.	World Meteorological Organization (WMO)
OBASI, Mr. G.O.P.	World Meteorological Organization (WMO)
PIEYNS, Mr. S.	World Meteorological Organization (WMO)
RODDA, Mr. J.	World Meteorological Organization (WMO)

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3. ORGANIZATIONS WITH OBSERVER STATUS WITH THE UNITED NATIONS

ABU-GHARBIYEH, Mr. M.	Palestine

4. REPRESENTATIVES FROM INTER-GOVERNMENTAL ORGANIZATIONS

BURTON, Mr. J.	Agence de Coopération Culturelle et Technique (ACCT)
KHOURI, Mr. B.	Arab Centre for the Studies of Arid Zones (ACSAD)
McINTOSH, Mr. A. Ch.	Asian Development Bank (ADB)
OUSMANE, Mr. B.	Comité Inter-Africain de Lutte contre la Sécheresse au Sahel (CILSS)
DIAGANA, Mr. B.	Comité Interafricain d'Etudes Hydrauliques (CIEH)
MANDL, Mr. V.	Commission of the European Communities (CEC)
CLARKE, Mr. T.	Commission of the European Communities (CEC)
PIAVAUX, Mr. A.	Commission of the European Communities (CEC)
TAWFIK, Mr. M.M.	HYDROMET
KULSHRESTHA, Mr. S.	International Institute for Applied Systems Analysis (IIASA)
SOMLYODY, Mr. L.	International Institute for Applied Systems Analysis (IIASA)
LENTON, Mr. R.	International Irrigation Management Institute (IIMI)
IRIVBOJE, Mr. O.C.	Lake Chad Basin Commission (LCBC)
JAURO, Mr. A.B.	Lake Chad Basin Commission (LCBC)
DA CUNHA, Mr. L.V.	North Atlantic Treaty Organization (NATO)
BAILE, Ms. S.	Organization for Economic Co-operation and Development (OECD)
EZZAT, Mr. M.N.	Permanent Joint Technical Commission for the Nile (PJTC)
HAMAD Mr. B.M.	Permanent Joint Technical Commission for the Nile (PJTC)
MOHAMED, Mr. K.A.	Permanent Joint Technical Commission for the Nile (PJTC)
SEOUD, Mr. A.A.	Permanent Joint Technical Commission for the Nile (PJTC)
MAKHOALIBE, Mr. S.	Southern African Development Co-ordination Conference (SADCC)

5. REPRESENTATIVES FROM NON-GOVERNMENTAL ORGANIZATIONS

NAGLE, Mr. W.J.	American Water Works Association (AWWA)
BRAGA, Mr. B.P.	Associacao Brasileira de Recursos Hidricos (ABRH)
CANEDO, Mr. P.	Associacao Brasileira de Recursos Hidricos (ABRH)
MATTOS DE LEMOS, Mr. H.	Brazilian Committee for UNEP
PARCELLS, Mr. S.	CAPE 92
ROBERT, Mr. D.J.	Centre international pour la Formation à la Gestion des Ressources en Eau (CEFIGRE)
COLENBRANDER, Mr. H.	Committee on Water Research (COWAR)
PLATE, Mr. E.	Committee on Water Research (COWAR)
MOORE, Ms. D.	Environment Defense Fund (EDF)
HAMILTON, Mr. A.G.	Friends of the Earth/Earthwatch
STARR, Ms. J.	Global Water Summit Initiative
VAN BRONCKHORST, Mr. B.	Globetree Foundation
KINGHAN, Ms. H.	Greenpeace Ireland
MARGAT, Mr. J.	Institut Méditerranéen de l'Eau (IME)
POTIE, Mr. Louis	Institut Méditerranéen de l'Eau (IME)

CLARKE, Mr. K.	Institution of Water and Environmental Management (IWEM)
MILBURN, Mr. A.	International Association on Water Pollution Research and Control (IAWPRC)
MULLER, Mr. A.	International Association for Hydraulic Research (IAHR)
CAPONERA, Mr. D.	International Association for Water Law (IAWL)
LLAMAS, Mr. M.R.	International Association of Hydrogeologists (IAH)
SKINNER, Mr. A.C.	International Association of Hydrogeologists (IAH)
SHAMIR, Mr. U.	International Association of Hydrological Sciences (IAHS)
MURRAY, Mr. D.	International Association of Theoretical and Applied Limonology (IATAL)
SCANNELL, Ms. Y.	International Commission of Water Law (ICWL)
HENNESSY, Mr. J.	International Commission on Irrigation and Drainage (ICID)
SCANNELL, Ms. Y.	International Council of Environmental Law (ICEL)
JORGENSEN, Mr. S.	International Council of Environmental Law (ICEL)
McKEAGUE, Ms. P.	International Council of Environmental Law (ICEL)
STAFFORD, Mr. L.	International Fertilizer Industry Association (IFIA)
MORIYA, Mr. M.	International Lake Environment Committee Foundation (ILEC)
JULKUNEN, Ms. P.	International Life Sciences Institute (ILSI)
DUGAN, Mr. P.	International Union for the Conservation of Nature (IUCN)
HOOD, Mr. D.E.	International Union of Food Science and Technology (IUFOST)
STOUT, Mr. G.	International Water Resources Association (IWRA)
BAYS, Mr. L.	International Water Supply Association (IWSA)
TESSENDORF, Mr. H.	International Water Supply Association (IWSA)
NOLLKAEMPER, Mr. A.	International Water Tribunal (IWT)
WAGNER, Mr. M.	NUOI
TRAORE, Ms. A.	PROWWESS/Afrique/UNIFEM
LETHIER, Mr. H.	RAMSAR Convention Bureau
CHABERT D'HIERES, Mr. L.	The International Secretariat for Water (ISW)
JOST, Mr. R.	The International Secretariat for Water (ISW)
KING, Mr. N.	WATER AID
NAGLE, Mr. W.J.	Water for People
FRANCEYS, Mr. R.W.A.	WEDC
KING-VOLCY, Ms. N.	Worldwide Fund for Nature (WWF)

6. ICWE SECRETARIAT

ANUKAM, Mr. L.	ICWE Secretariat
BLANC, Ms. V.	ICWE Secretariat
GORRE-DALE, Ms E.	ICWE Secretariat
DIAWARA, Mr. A.	ICWE Secretariat
IBREKK, Mr. H.O.	ICWE Secretariat
YABI, Ms. M.	ICWE Secretariat
YOUNG, Mr. G.	ICWE Secretariat

7. DOE IRELAND

AISLING, Mr. G.	IRELAND
COSTIGAN, Ms. M.	IRELAND
DOWNES, Ms. E.	IRELAND
DUNNE, Mr. D.	IRELAND
DUNNE, Ms. C.	IRELAND
KEENAN, Ms. J.	IRELAND
MACKEN, Mr. P.	IRELAND
McGUINESS, Ms. A.	IRELAND
NOONE, Ms M.	IRELAND
RYAN, Mr. C.	IRELAND

ANNEX II

The General Conference Programme

Sunday 26 January	10.00-18.00	Participants' registration at Burlington Hotel
	17.30	Press Conference
	19.00	Opening ceremony and Cultural Programme
Monday 27 January	09.30-10.30	Opening remarks by the Minister for the Environment Election of Chairpersons and Rapporteurs
	10.30-12.30	Plenary sessions 1 & 2 (Keynote Papers)
	14.30-17.30	Plenary sessions 3 & 4 (Keynote Papers) Administrative session
Tuesday 28 January	09.30-12.30	Working Group sessions A, C, E
	14.30-17.30	Working Group sessions B, D, F
	20.00	State Reception at Dublin Castle
Wednesday 29 January	09.30-11.00	Working Group sessions A, C, E
	11.00-12.30	Working Group sessions B, D, F
	13.00-14.00	Press Conference
	14.30-18.30	Exhibition at Dublin Castle continues until Saturday 1 February
	14.30-18.30	Poster sessions at Dublin Castle
Thursday 30 January	10.00-12.30	Working Group of the Whole
	14.30-17.30	Working Group of the Whole Excursions
	20.30	State Dinner at Burlington Hotel
Friday 31 January	10.00-12.30	Adoption of Dublin Statement
	13.00-14.00	Press Conference
	14.30-17.30	Adoption of Report of Conference Closing Ceremony